

What is claimed is:

1. A boundary detection method for detecting a boundary between areas having different features among arbitrary adjacent areas in image data, comprising:

extracting feature information depending on all pixels in a unit area for each unit area of the image data;

10 obtaining a difference in the feature information between adjacent unit areas for an arbitrary unit area; and

determining as the boundary the unit area whose difference is at or higher than a predetermined level.

2. A boundary detection method for detecting a boundary between areas having different pixel arrangements among arbitrary adjacent areas in image data, comprising:

20 extracting image frequency information for each unit area of the image data;

determining representative feature information according to the extracted image frequency information;

obtaining a difference in the representative feature information between adjacent unit areas for an arbitrary unit area; and

5 determining as the boundary the unit area whose difference is at or higher than a predetermined level.

3. A boundary detection method for detecting a boundary between areas having different pixel  
10 arrangements among arbitrary adjacent areas in image data, comprising:

extracting first image frequency information of predetermined types for each first unit area of the image data;

15 defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative feature information;

provisionally determining as the boundary a  
20 first unit area whose variance from the representative feature information of an adjacent first unit area is at or higher than a predetermined level in an arbitrary first unit area;

25 extracting second image frequency information

for each second unit area smaller than the first unit area in the first unit area provisionally determined as the boundary and a vicinal area of the first unit area; and

5           determining as the boundary a second unit area whose value based on the variance from the second image frequency information of the adjacent second unit area is at or higher than a predetermined level in an arbitrary second unit area.

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4.    A boundary detection method for detecting, in input image data of an original whose front image is input with a background board as its background, a boundary between the background board and the original for the input image data of an image of a part of the background board and an edge of the original input in a same color; comprising:

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          performing a Fourier-transform on each first unit area of the input image data;

20           extracting first image frequency information of predetermined types obtained by the Fourier-transform processing;

          defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative

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feature information for each of the first unit area;

provisionally determining as the boundary a corresponding area on an approximate line obtained  
5 by performing line approximation on a first unit area whose variance from the representative feature information about an adjacent first unit area is at or higher than a predetermined level in an arbitrary first unit area;

10 performing a Fourier-transform on each second unit area smaller than the first unit area in the first unit area provisionally determined as the boundary and a vicinal area of the first unit area;

extracting second image frequency information  
15 of predetermined types obtained by the Fourier-transform;

defining as representative feature information a value obtained by adding a predetermined weight to each type of the extracted second image  
20 frequency information for each second unit area;

performing a Wavelet transform on the representative feature information;

performing line approximation on a second unit area whose value for each second unit area obtained  
25 by the Wavelet transform is at or higher than a

predetermined level; and

determining a position on the approximate line obtained by the line approximation as the boundary.

- 5        5.        The method according to claim 4, wherein  
              in image data in which the original is  
              surrounded by the background board, the boundary is  
              detected from four different directions parallel or  
              orthogonal to each other on the image data.
- 10       6.        The method according to claim 1, wherein  
              a printing area is first designated for the  
              image data, and image data from which the printing  
              area is excluded is defined as a target for  
15        detecting the boundary.
7.        The method according to claim 2, wherein  
              a printing area is first designated for the  
              image data, and image data from which the printing  
20        area is excluded is defined as a target for  
              detecting the boundary.
8.        The method according to claim 3, wherein  
              a printing area is first designated for the  
25        image data, and image data from which the printing

area is excluded is defined as a target for detecting the boundary.

9. The method according to claim 4, wherein

5 a printing area is first designated for the input image data, and input image data from which the printing area is excluded is defined as a target for detecting the boundary.

10 10. The method according to claim 1, wherein

said feature information comprises a high frequency element, a low frequency element, a direct current element, and a frequency distribution.

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11. The method according to claim 5, wherein

when the determined boundary forms a rectangle, cant correction is performed on an area contained in the rectangle based on the boundary.

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12. The method according to claim 5, wherein

based on the determined boundary, one area adjacent to the boundary or an original portion of the image data is left, and the other area or a background board of the image data is removed.

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13. The method according to claim 11, wherein

based on the determined boundary, one area adjacent to the boundary or an original portion of the image data is left, and the other area or a background board of the image data is removed.

14. The method according to claim 5, wherein:

based on the determined boundary, one area adjacent to the boundary or a background board portion of the image data is colored in black; and

a character contained in the other area adjacent to the boundary than the area colored in black is recognized.

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15. The method according to claim 11, wherein:

based on the determined boundary, one area adjacent to the boundary or a background board portion of the image data is colored in black; and

a character contained in an area adjacent to the boundary other than the area colored in black is recognized.

16. A computer-readable handy storage medium storing a program used to direct a computer to

perform a process of detecting a boundary between areas having different features among arbitrary adjacent areas in image data, comprising the functions of:

5           extracting feature information depending on all pixels in a unit area for each unit area of the image data;

          obtaining a difference in the feature information between adjacent unit areas for an  
10           arbitrary unit area; and

          determining as the boundary the unit area whose difference is at or higher than a predetermined level.

15       17. A computer-readable handy storage medium storing a program used to direct a computer to perform a process of detecting a boundary between areas having different pixel arrangements among arbitrary adjacent areas in image data, comprising  
20       the functions of:

          extracting image frequency information for each unit area of the image data;

          determining representative feature information according to the extracted image frequency  
25       information;



obtaining a difference in the representative feature information between adjacent unit areas for an arbitrary unit area; and

5 determining as the boundary the unit area whose difference is at or higher than a predetermined level.

18. A computer-readable handy storage medium storing a program used to direct a computer to  
10 perform a process of detecting a boundary between areas having different pixel arrangements among arbitrary adjacent areas in image data, comprising the functions of:

extracting first image frequency information  
15 of predetermined types for each first unit area of the image data;

defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative  
20 feature information;

provisionally determining as the boundary a first unit area whose variance from the representative feature information of an adjacent first unit area is at or higher than a  
25 predetermined level in an arbitrary first unit

area;

extracting second image frequency information  
for each second unit area smaller than the first  
unit area in the first unit area provisionally  
5 determined as the boundary and a vicinal area of  
the first unit area; and

determining as the boundary a second unit area  
whose value based on the variance from the second  
image frequency information of the adjacent second  
10 unit area is at or higher than a predetermined  
level in an arbitrary second unit area.

19. A computer-readable handy storage medium  
storing a program used to direct a computer to  
15 perform a process of detecting, in input image data  
of an original whose front image is input with a  
background board as its background, a boundary  
between the background board and the original for  
the input image data of an image of a part of the  
20 background board and an edge of the original input  
in the same color; comprising the functions of:

performing a Fourier-transform on each first  
unit area of the input image data;

extracting first image frequency information  
25 of predetermined types obtained by the Fourier-

transform processing;

defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative  
5 feature information for each of the first unit areas;

provisionally determining as the boundary a corresponding area on an approximate line obtained by performing line approximation on a first unit  
10 area whose variance from the representative feature information about an adjacent first unit area is at or higher than a predetermined level in an arbitrary first unit area;

performing a Fourier-transform on each second  
15 unit area smaller than the first unit area in the first unit area provisionally determined as the boundary and a vicinal area of the first unit area;

extracting second image frequency information of predetermined types obtained by the Fourier-  
20 transform;

defining as representative feature information a value obtained by adding a predetermined weight to each type of the extracted second image frequency information for each second unit area;

25 performing a Wavelet transform on the

representative feature information;

performing line approximation on a second unit area whose value for each second unit area obtained by the Wavelet transform is at or higher than a predetermined level; and

determining a position on the approximate line obtained by the line approximation as the boundary.

20. The storage medium according to claim 19,  
10 wherein

said program further directs the computer to realize the function of detecting, in image data in which the original is surrounded by the background board, the boundary from four different directions parallel or orthogonal to each other on the image data.

21. The storage medium according to claim 16,  
wherein

20 said program further directs the computer to realize the function of first designating a printing area for the image data, and defining image data from which the printing area is excluded as a target for detecting the boundary.

22. The storage medium according to claim 17,  
wherein

said program further directs the computer to  
realize the function of first designating a  
5 printing area for the image data, and defining  
image data from which the printing area is excluded  
as a target for detecting the boundary.

23. The storage medium according to claim 18,  
10 wherein

said program further directs the computer to  
realize the function of first designating a  
printing area for the image data, and defining  
image data from which the printing area is excluded  
15 as a target for detecting the boundary.

24. The storage medium according to claim 19,  
wherein

said program further directs the computer to  
20 realize the function of first designating a  
printing area for the input image data, and  
defining input image data from which the printing  
area is excluded as a target for detecting the  
boundary.

25. The storage medium according to claim 16,  
wherein

said feature information comprises a high  
frequency element, a low frequency element, a  
5 direct current element, and a frequency  
distribution.

26. The storage medium according to claim 20,  
wherein

10 said program further directs the computer to  
perform cant correction on an area contained in the  
rectangle based on the boundary when the determined  
boundary forms a rectangle.

15 27. The storage medium according to claim 19,  
wherein

said program further directs the computer to  
leave one area adjacent to the boundary or an  
original portion of the image data, and remove the  
20 other area or a background board of the image data  
based on the determined boundary.

28. The storage medium according to claim 19,  
wherein

25 said program further directs the computer to

perform the functions of:

coloring one area adjacent to the boundary or a background board portion of the image data in black based on the determined boundary; and

5 recognizing a character contained in an area adjacent to the boundary other than the area colored in black.

29. An image processing device for detecting a  
10 boundary between areas having different features among arbitrary adjacent areas in image data, comprising:

a feature emphasis unit extracting feature information depending on all pixels in a unit area  
15 for each unit area of the image data; and

a boundary determination unit obtaining a difference in the feature information between adjacent unit areas for an arbitrary unit area, and determining as the boundary the unit area whose  
20 difference is at or higher than a predetermined level.

30. An image processing device for detecting a  
boundary between areas having different pixel  
25 arrangements among arbitrary adjacent areas in

image data, comprising:

a feature emphasis unit extracting image frequency information for each unit area of the image data; and

5 a boundary determination unit determining representative feature information according to the extracted image frequency information, obtaining a difference in the representative feature information between adjacent unit areas for an  
10 arbitrary unit area, and determining as the boundary the unit area whose difference is at or higher than a predetermined level.

31. An image processing device for detecting a  
15 boundary between areas having different pixel arrangements among arbitrary adjacent areas in image data, comprising:

a feature emphasis unit extracting first image frequency information of predetermined types for  
20 each first unit area of the image data;

a boundary provisional determination unit defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative feature  
25 information, and provisionally determining as the



boundary a first unit area whose variance from the representative feature information of an adjacent first unit area is at or higher than a predetermined level in an arbitrary first unit area; and

5           a boundary determination unit extracting second image frequency information for each second unit area smaller than the first unit area in the first unit area provisionally determined as the  
10       boundary and a vicinal area of the first unit area, and determining as the boundary a second unit area whose value based on the variance from the second image frequency information of the adjacent second unit area is at or higher than a predetermined  
15       level in an arbitrary second unit area.

32.   An image processing device for detecting, in input image data of an original whose front image is input with a background board as its background,  
20       a boundary between the background board and the original for the input image data of an image of a part of the background board and an edge of the original input in a same color; comprising:

          a feature emphasis unit performing a Fourier-  
25       transform on each first unit area of the input

image data, and extracting first image frequency information of predetermined types obtained by the Fourier-transform processing;

5 a boundary provisional determination unit defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative feature information for each of the first unit area, and provisionally determining as the boundary a  
10 corresponding area on an approximate line obtained by performing line approximation on a first unit area whose variance from the representative feature information about an adjacent first unit area is at or higher than a predetermined level in an  
15 arbitrary first unit area; and

a boundary determination unit performing a Fourier-transform on each second unit area smaller than the first unit area in the first unit area provisionally determined as the boundary and a  
20 vicinal area of the first unit area, extracting second image frequency information of predetermined types obtained by the Fourier-transform, defining as representative feature information a value obtained by adding a predetermined weight to each  
25 type of the extracted second image frequency

information for each second unit area, performing a Wavelet transform on the representative feature information, performing line approximation on a second unit area whose value for each second unit  
5 area obtained by the Wavelet transform is at or higher than a predetermined level, and determining a position on the approximate line obtained by the line approximation as the boundary.

10 33. The device according to claim 32, wherein each of said units functions in four different directions parallel or orthogonal to each other on the image data in which an original is surrounded by the background board.

15 34. The device according to claim 29, further comprising a printing area exclusion unit excluding a printing area of the image data from targets from  
20 which a boundary between areas having different features is detected.

35. The device according to claim 29, wherein said feature information comprises a high  
25 frequency element, a low frequency element, a

direct current element, and a frequency distribution.

36. The device according to claim 32, further  
5 comprising

an image reading unit optically reading an original and generating the image data of the original.

10 37. The device according to claim 33, further comprising

a cant correction unit for correcting cant of an area contained in a rectangle when the determined boundary forms the rectangle.

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38. The device according to claim 32, further comprising

20 an image exclusion unit leaving one area adjacent to the boundary or an original portion of the image data, and removing the other area or a background board of the image data based on the determined boundary.

39. The device according to claim 32, further  
25 comprising:

an image coloring unit coloring one area adjacent to the boundary or a background board portion of the image data in black based on the determined boundary; and

5           a character recognition unit recognizing a character contained in an area adjacent to the boundary other than the area colored in black.

40. A copying machine which provides a background  
10 board on a back of an original, reads image information about the original, and outputs a copy of the original with a size of the original designated based on detection of a boundary between the background board and the original, comprising:

15           a printing area exclusion unit excluding a printing area of image information;

          a feature emphasis unit extracting feature information depending on all image information in a unit area for each unit area of the image  
20 information; and

          a boundary determination unit obtaining a difference in the feature information between adjacent unit areas for an arbitrary unit area, and determining as the boundary the unit area other  
25 than the printing area whose difference is at or

higher than a predetermined level.

41. A copying machine which provides a background  
board on a back of an original, reads image  
5 information about the original, and outputs a copy  
of the original with a size of the original  
designated based on detection of a boundary between  
the background board and the original, comprising:

a printing area exclusion unit excluding a  
10 printing area of image information;

a feature emphasis unit extracting image  
frequency information for each unit area of the  
image information; and

a boundary determination unit determining  
15 representative feature information according to the  
extracted image frequency information, obtaining a  
difference in the representative feature  
information between adjacent unit areas for an  
arbitrary unit area, and determining as the  
20 boundary the unit area other than the printing area  
whose difference is at or higher than a  
predetermined level.

42. A copying machine which provides a background  
25 board on a back of an original, reads image

information about the original, and outputs a copy of the original with a size of the original designated based on detection of a boundary between the background board and the original, comprising:

5           a printing area exclusion unit excluding a printing area of image information;

          a feature emphasis unit extracting first image frequency information of predetermined types for each first unit area of the image information;

10           a boundary provisional determination unit defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative feature information, and provisionally determining as the  
15           boundary a first unit area whose variance from the representative feature information of an adjacent first unit area is at or higher than a predetermined level in an arbitrary first unit area; and

20           a boundary determination unit extracting second image frequency information for each second unit area smaller than the first unit area in the first unit area provisionally determined as the boundary and a vicinal area of the first unit area,  
25           and determining as the boundary a second unit area

whose value based on the variance from the second image frequency information of the adjacent second unit area is at or higher than a predetermined level in an arbitrary second unit area.

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43. A copying machine which provides a background board on a back of an original, reads image information about the original, and outputs a copy of the original with a size of the original designated based on detection of a boundary between  
10 the background board and the original, comprising:

a printing area exclusion unit excluding a printing area of image information;

a feature emphasis unit performing a Fourier-  
15 transform on each first unit area of the input image information, and extracting first image frequency information of predetermined types obtained by the Fourier-transform processing;

a boundary provisional determination unit  
20 defining a value obtained by adding a predetermined weight to each type of the extracted first image frequency information as representative feature information for each of the first unit areas, and provisionally determining as the boundary a  
25 corresponding area on an approximate line obtained



by performing line approximation on a first unit area other than the printing area whose variance from the representative feature information about an adjacent first unit area is at or higher than a  
5 predetermined level in an arbitrary first unit area; and

a boundary determination unit performing a Fourier-transform on each second unit area smaller than the first unit area in the first unit area  
10 provisionally determined as the boundary and a vicinal area of the first unit area, extracting second image frequency information of predetermined types obtained by the Fourier-transform, defining as representative feature information a value  
15 obtained by adding a predetermined weight to each type of the extracted second image frequency information for each second unit area, performing a Wavelet transform on the representative feature information, performing line approximation on a  
20 second unit area whose value for each second unit area obtained by the Wavelet transform is at or higher than a predetermined level, and determining a position on the approximate line obtained by the line approximation as the boundary.

44. The copying machine according to claim 43,  
wherein

each of said units functions in four different  
directions parallel or orthogonal to each other on  
5 the image information in which an original is  
surrounded by the background board.

45. The copying machine according to claim 40,  
wherein

10 a printing area of the image information is  
excluded based on a gray scale value.

46. An image processing device for detecting a  
boundary between areas having different features  
15 among arbitrary adjacent areas in image data,  
comprising:

feature emphasis means for extracting feature  
information depending on all pixels in a unit area  
for each unit area of the image data; and

20 boundary determination means for obtaining a  
difference in the feature information between  
adjacent unit areas for an arbitrary unit area, and  
determining as the boundary the unit area whose  
difference is at or higher than a predetermined  
25 level.

47. A copying machine which provides a background board on a back of an original, reads image information about the original, and outputs a copy  
5 of the original with a size of the original designated based on detection of a boundary between the background board and the original, comprising:

printing area exclusion means for excluding a printing area of image information;

10 feature emphasis means for extracting feature information depending on all image information in a unit area for each unit area of the image information; and

15 boundary determination means for obtaining a difference in the feature information between adjacent unit areas for an arbitrary unit area, and determining as the boundary the unit area other than the printing area whose difference is at or higher than a predetermined level.

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